Clinical Application of a New Flexible Knitted Dacron Arterial Substitute*

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The direct surgical treatment of various forms of aortic and arterial disease often requires a vascular replacement. Homografts were first employed successfully for this purpose and both technically and functionally have provided gratifying results. Their major disadvantage, however, lies in the inconvenience associated with their procurement and preparation, and the fact that they are not available in sufficient quantities to meet the increasing demands for their use. For these reasons attention has been directed toward development of a satisfactory arterial substitute for homografts which would be free of these disadvantages. In cooperation with Prof. Thomas Edman, of the Philadelphia Textile Institute, a new flexible knitted Dacron tube has been devised which on the basis of experimental and clinical studies has been found to meet this objective. Among its desirable characteristics are the following: First, it may be repeatedly sterilized by autoclaving in the usual manner without harm to or weakening of the fabric. Second, owing to its knitted construction, it is nonfraying and may be cut with the scissors or scalpel at any angle, or holes may be cut in its side for anastomosis of branches. Third, it is flexible and elastic, thus facilitating its anatomical and technical application. Fourth, it may be clamped with arterial clamps without harm to the fabric. Fifth, it is available in tubes of various sizes and shapes, including secondary branches for ready adaptability to all segments of the major arterial system. This exhibit demonstrates the clinical application of this arterial substitute based upon our experience in 737 cases.

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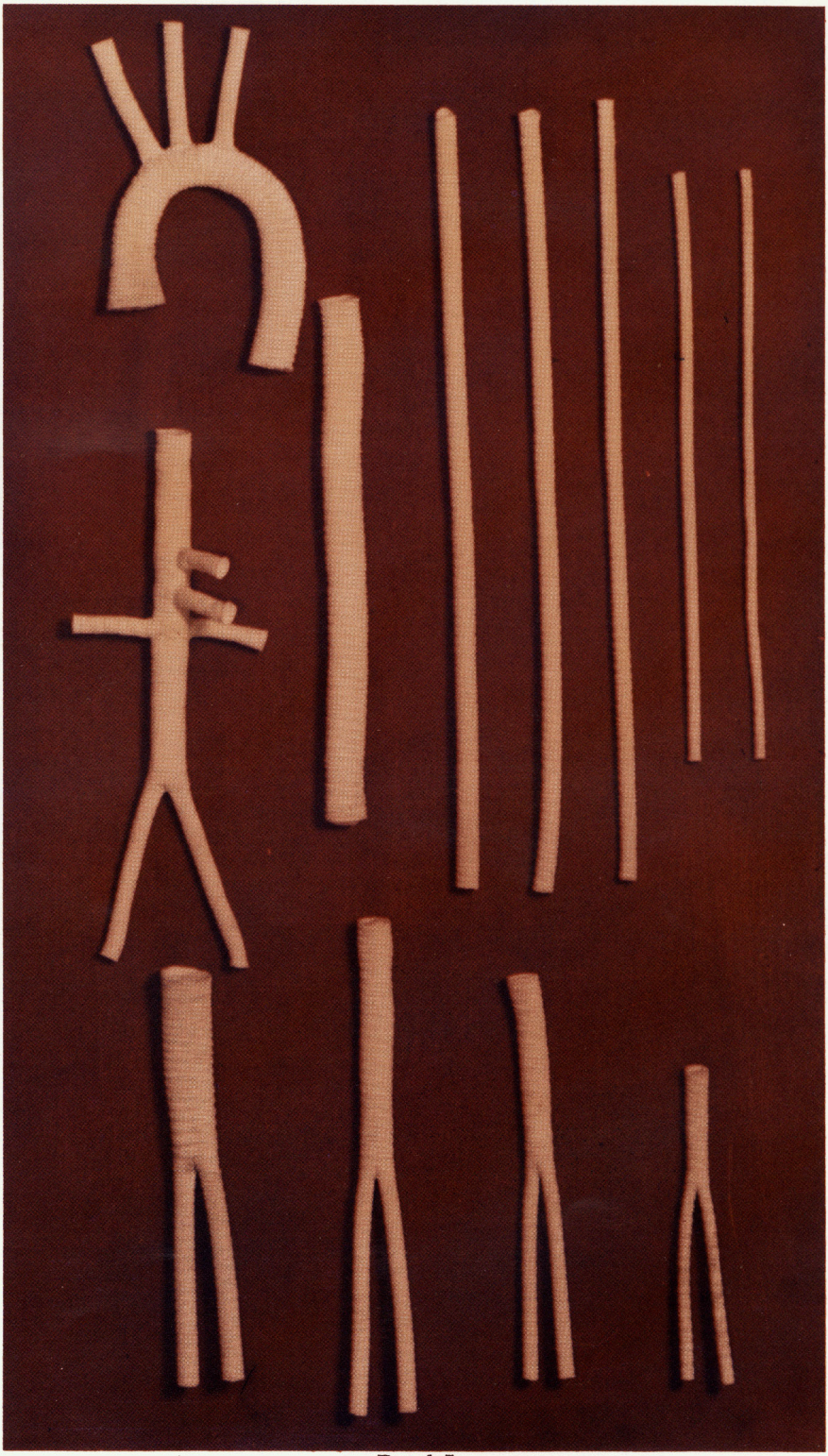


Panel I

This panel shows the various types and sizes of the Dacron grafts for replacement of different anatomical segments of the aorta and peripheral arteries.

Fig. 1. — Angiocardiogram showing aneurysms involving distal part of ascending aorta and transverse arch, as indicated by drawing in inset.

Fig. 2. — Same case as in Figure 1 showing method of resection of aortic arch and Dacron graft replacement. Drawings in upper part of Figure illustrate operative procedure using Dacron grafts for temporary bypass to maintain aortic and cerebral circulation during excision and graft replacement and subsequent conversion into the permanent graft. Photograph in lower part of Figure made at operation shows completed procedure.

Fig. 3.—*(a)* Drawing showing method of temporary bypass from ascending to descending aorta using Dacron graft for maintaining aortic circulation during excision and graft replacement of a fusiform aneurysm of transverse arch of aorta. *(b)* Drawing showing completed procedure with Dacron graft replacement of excised segment of transverse arch and with restoration of continuity to left subclavian artery.

Fig. 4. — Photograph made at operation in same case as in Figure 3 showing completed procedure of resection with replacement by Dacron graft, including anastomosis to left subclavian artery and use of bypass Dacron graft from ascending to descending aorta.

Fig. 5. — Angiocardiogram of patient with dissecting aneurysm of descending thoracic aorta showing characteristic double aortic lumen produced by relative difference in concentrations of dye in true and false aortic lumens, as depicted in diagram in inset.

Fig. 6. — Photograph made at operation in same patient as in Figure 5 showing completed replacement of the segment of aorta and dissecting aneurysm with Dacron grafts.

Fig. 7. — Angiocardiogram in same patient as in Figures 5 and 6 made approximately seven months after operation, showing relatively normal outline of thoracic aorta. Patient has been completely relieved and has resumed normal activity.

Fig. 8. — Photograph of sagittal section of resected segment of dissecting aneurysm in same patient as in Figures 5 to 8, showing gross pathologic features of lesion, with arrow pointing to intimal tear through which true lumen communicated with false lumen.

Panel II

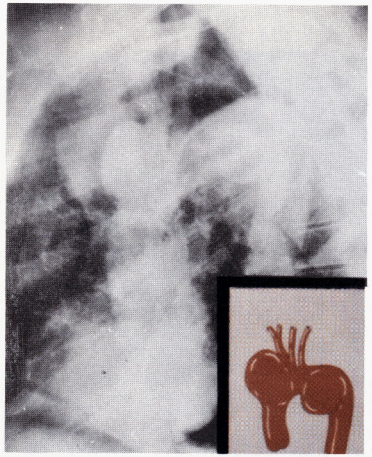


Fig. 1

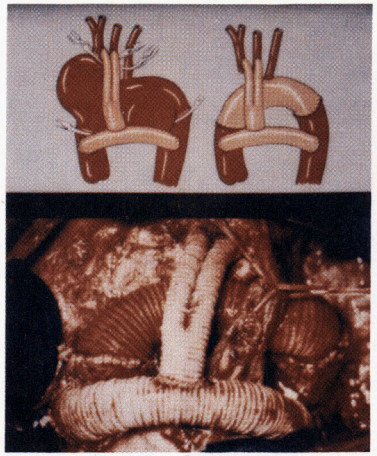


Fig. 2

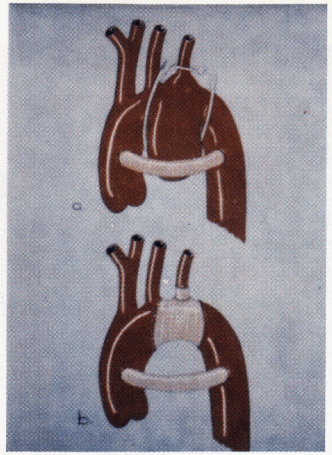


Fig. 3

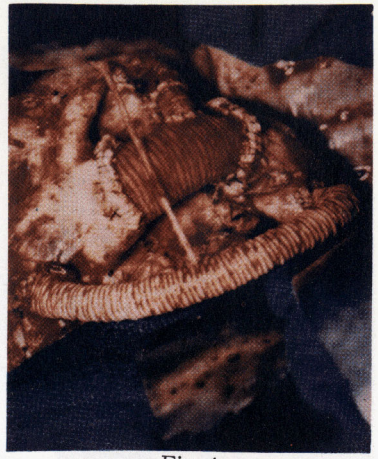


Fig. 4

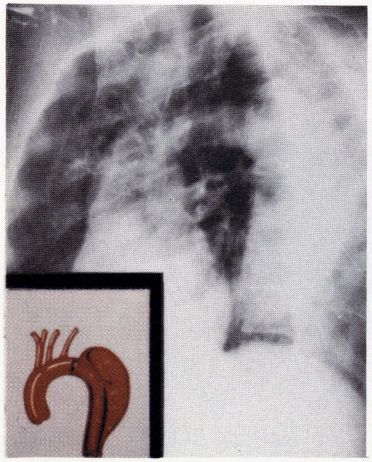


Fig. 5

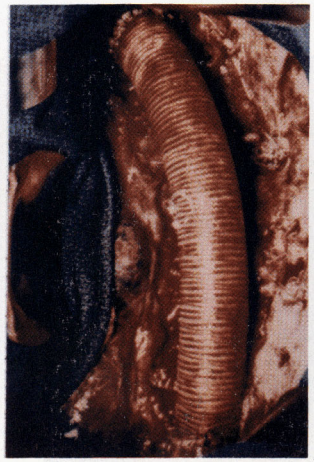


Fig. 6

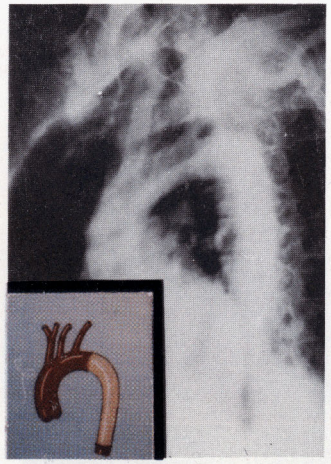


Fig. 7

Fig. 8

Panel II

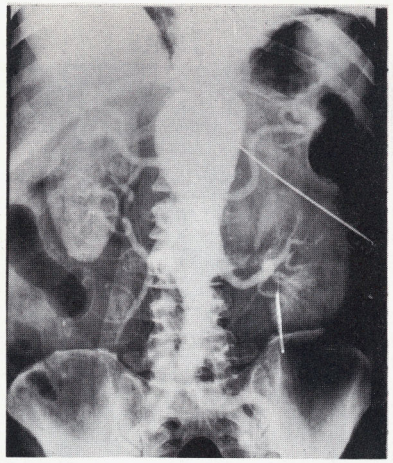


Fig. 1

Fig. 2

Fig. 3

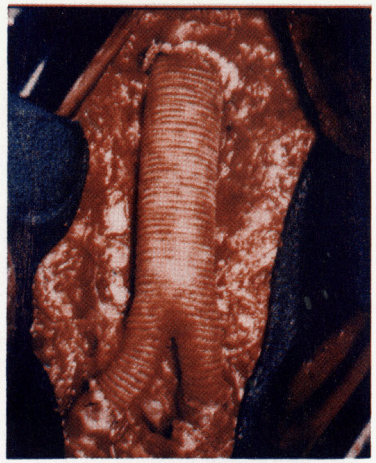


Fig. 4

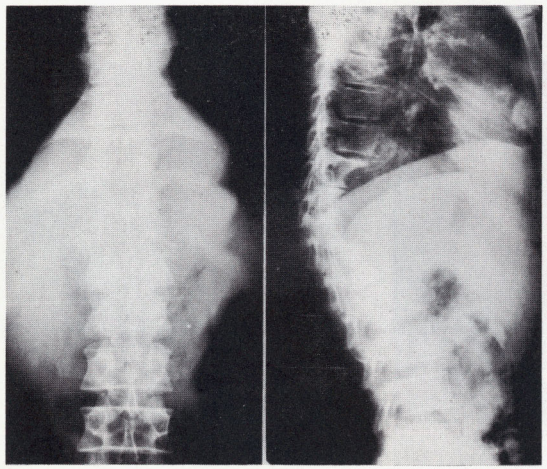


Fig. 5

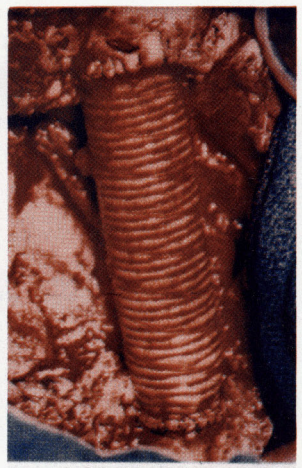


Fig. 6

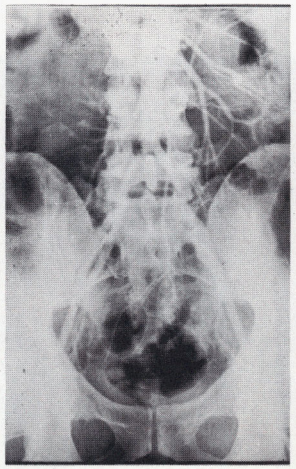


Fig. 7

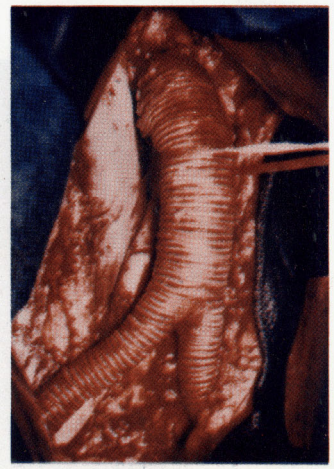


Fig. 8

Panel III

Fig. 1. — Aortogram showing fusiform aneurysm arising in distal segment of descending thoracic aorta and extending down to involve entire segment of abdominal aorta, including celiac, superior mesenteric, and renal arteries.

Fig. 2. — Photograph in same case as in Figure 1 made at operation, showing completed replacement of excised segment of thoracoabdominal aorta and aneurysm with Dacron graft, including branches to celiac, superior mesenteric, and both renal arteries. In the performance of this procedure the Dacron tube provides a significant advantage in that it permits conversion of the Dacron graft used first as a temporary shunt into the subsequent permanent graft.

Fig. 3. — Photograph made at operation showing characteristic appearance of an arteriosclerotic aneurysm of the abdominal aorta, arising just below the origin of the renal arteries and extending down to involve the bifurcation.

Fig. 4. — Photograph made at operation in same patient as in Figure 3 showing completed procedure following resection of aneurysm and replacement with bifurcation Dacron graft.

Fig. 5. — Roentgenograms of chest of patient showing mass in upper abdomen and lower mediastinum causing bone erosion, produced by syphilitic aneurysm of aorta.

Fig. 6. — Photograph in same case as in Figure 5 made at operation, showing completed replacement of excised segment of aorta and syphilitic aneurysm by means of Dacron graft.

Fig. 7. — Aortogram of patient with Leriche syndrome showing partial occlusion of the distal abdominal aorta and bifurcation with involvement of both common iliac arteries.

Fig. 8. — Photograph made at operation showing use of bifurcation Dacron graft in application of bypass principle in treatment of patient in Figure 7. The Dacron graft is attached by an end-to-side anastomosis to the abdominal aorta above and the external iliac artery below, thus bypassing the occlusive lesion.

Panel III

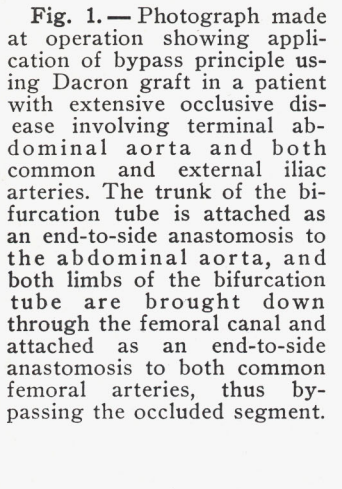


Fig. 1. — Photograph made at operation showing application of bypass principle using Dacron graft in a patient with extensive occlusive disease involving terminal abdominal aorta and both common and external iliac arteries. The trunk of the bifurcation tube is attached as an end-to-side anastomosis to the abdominal aorta, and both limbs of the bifurcation tube are brought down through the femoral canal and attached as an end-to-side anastomosis to both common femoral arteries, thus bypassing the occluded segment.

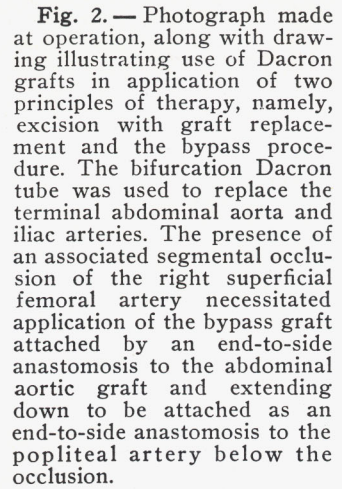


Fig. 2. — Photograph made at operation, along with drawing illustrating use of Dacron grafts in application of two principles of therapy, namely, excision with graft replacement and the bypass procedure. The bifurcation Dacron tube was used to replace the terminal abdominal aorta and iliac arteries. The presence of an associated segmental occlusion of the right superficial femoral artery necessitated application of the bypass graft attached by an end-to-side anastomosis to the abdominal aortic graft and extending down to be attached as an end-to-side anastomosis to the popliteal artery below the occlusion.

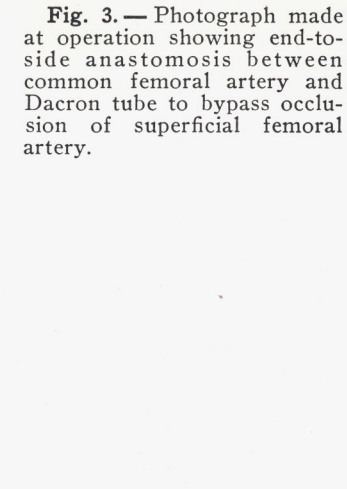


Fig. 3. — Photograph made at operation showing end-to-side anastomosis between common femoral artery and Dacron tube to bypass occlusion of superficial femoral artery.

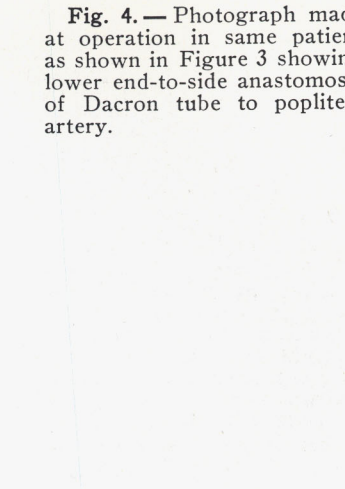


Fig. 4. — Photograph made at operation in same patient as shown in Figure 3 showing lower end-to-side anastomosis of Dacron tube to popliteal artery.

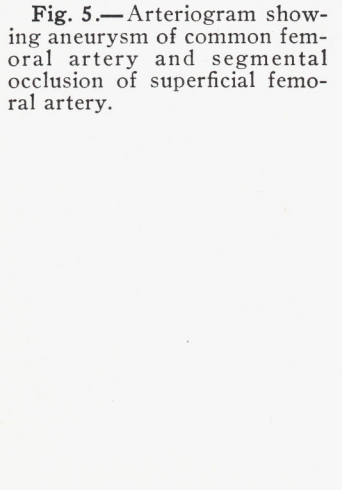


Fig. 5. — Arteriogram showing aneurysm of common femoral artery and segmental occlusion of superficial femoral artery.

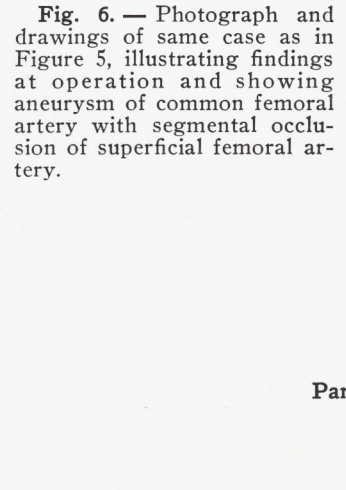


Fig. 6. — Photograph and drawings of same case as in Figure 5, illustrating findings at operation and showing aneurysm of common femoral artery with segmental occlusion of superficial femoral artery.

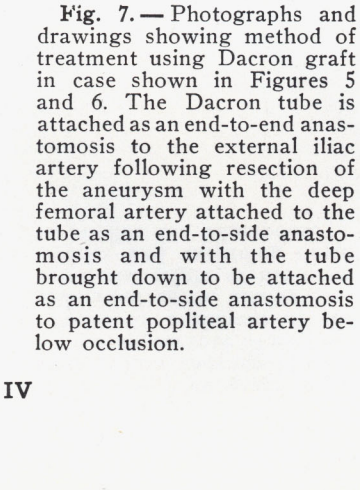


Fig. 7. — Photographs and drawings showing method of treatment using Dacron graft in case shown in Figures 5 and 6. The Dacron tube is attached as an end-to-end anastomosis to the external iliac artery following resection of the aneurysm with the deep femoral artery attached to the tube as an end-to-side anastomosis and with the tube brought down to be attached as an end-to-side anastomosis to patent popliteal artery below occlusion.

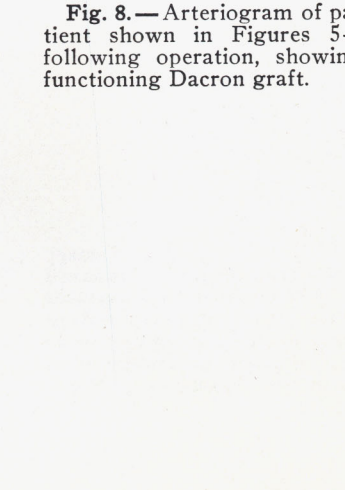


Fig. 8. — Arteriogram of patient shown in Figures 5-7 following operation, showing functioning Dacron graft.

Panel IV

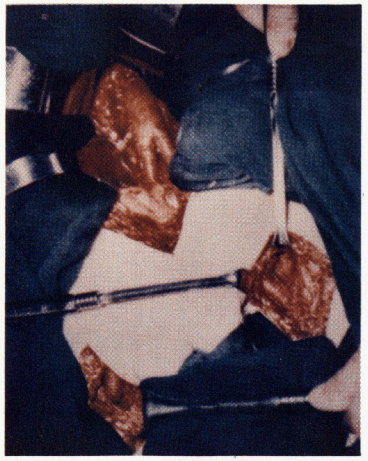


Fig. 1

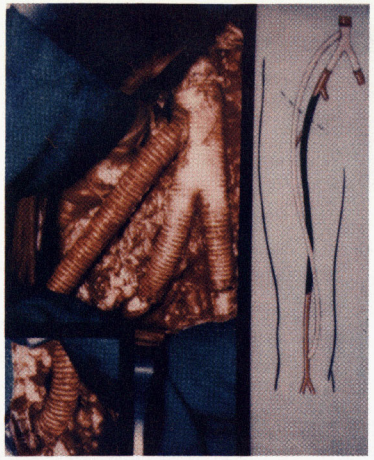


Fig. 2

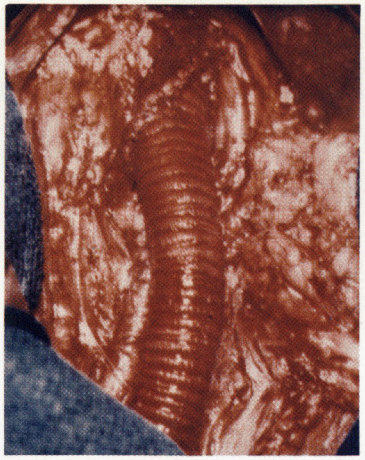


Fig. 3

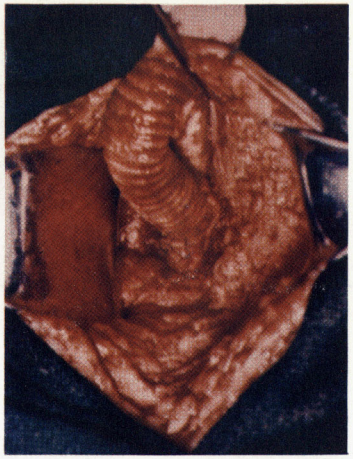


Fig. 4

Fig. 5

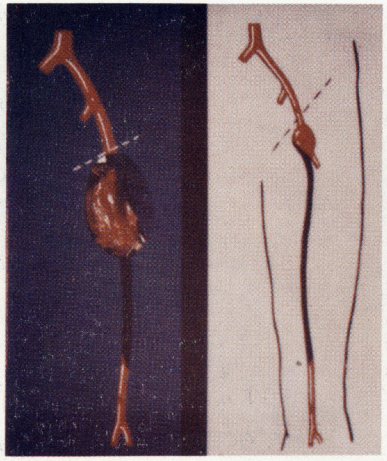


Fig. 6

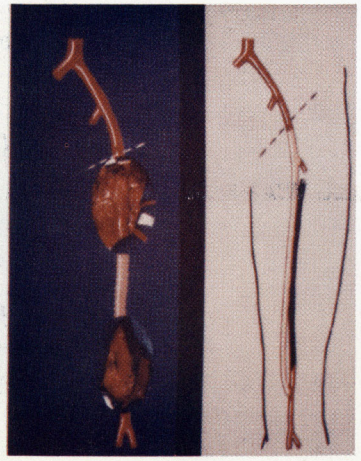


Fig. 7

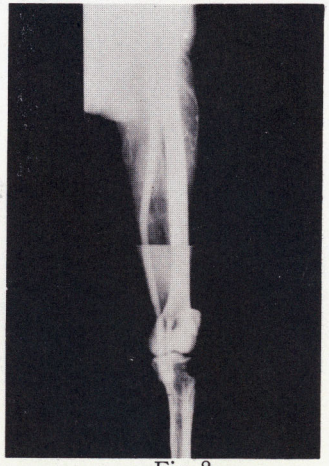


Fig. 8

Panel IV

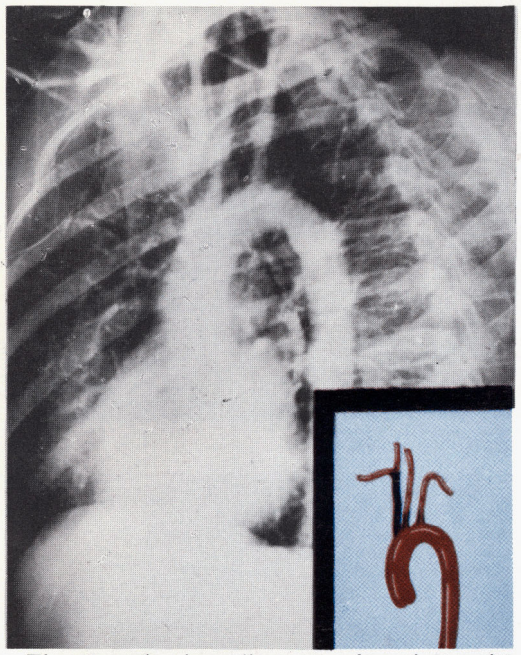


Fig. 1. — Angiocardiogram of patient with segmental thrombo-obliterative disease of branches of aortic arch (other terms include aortic arch syndrome, pulseless disease, or Takayasu's disease), showing complete occlusion of innominate artery and partial occlusion of left common carotid artery, as depicted by drawing in inset.

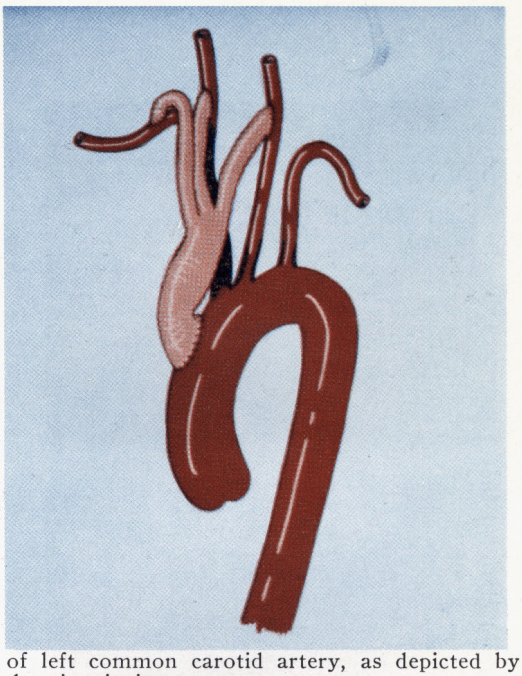


Fig. 2. — Drawing illustrating surgical procedure employed in treatment of patient shown in Figure 1, using trifurcation Dacron tube to bypass occlusion in innominate and left common carotid arteries.

Fig. 3. — Photographs made at operation in same case as that in Figures 1 and 2, showing, in lower portion, attachment of Dacron tube as an end-to-side anastomosisto ascending aorta and, in the upper part of the photograph, the three branches of the Dacron tube, shown through a collar incision in the neck. The tube on the right extends to the left common carotid artery to be attached as an end-to-side anastomosis. The center tube is shown attached as an end-to-side anastomosis to the right common carotid artery, and the tube on the left is extending out to be attached as an end-to-side anastomosis to the right subclavian artery.

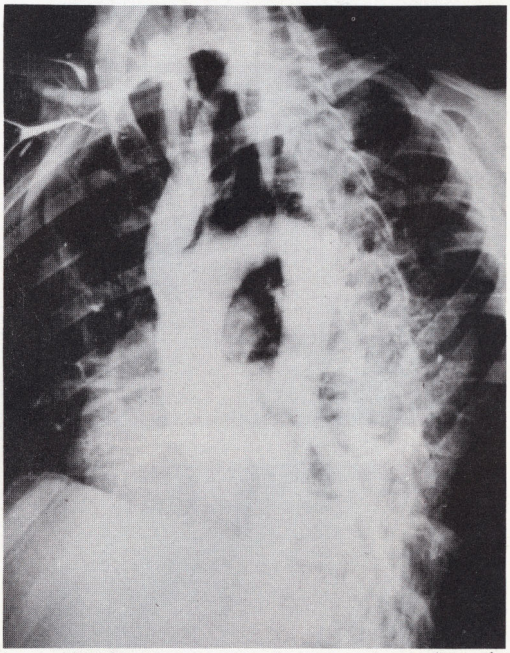


Fig. 4. — Angiocardiogram made after operation in case shown in Figures 1-3, showing functioning trifurcation Dacron tube and restoration of normal circulation.

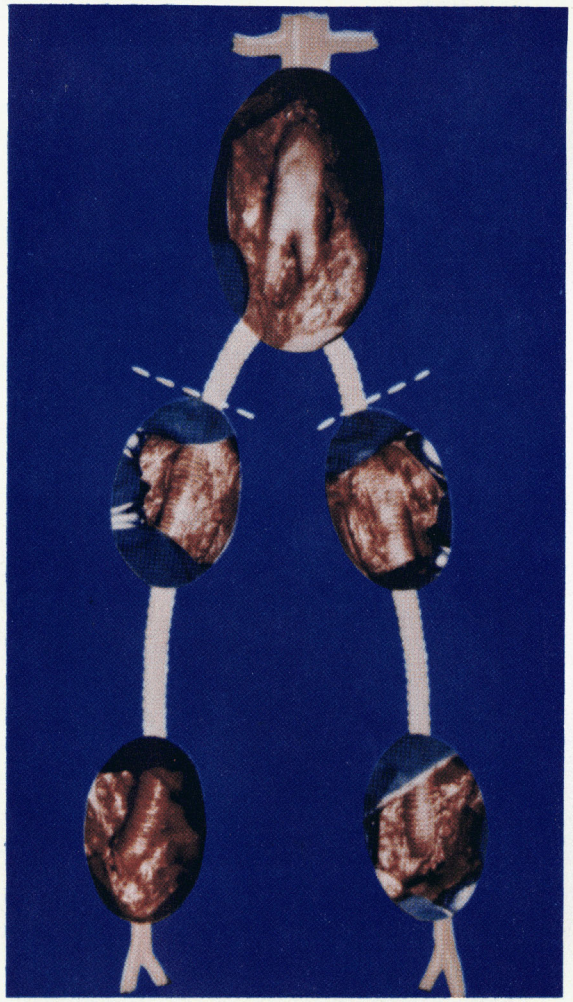


Fig. 1. — Photographs made at operation through five separate incisions, showing bypass bifurcation Dacron graft extending from abdominal aorta above to both common femoral and popliteal arteries below in treatment of extensive segmental occlusive disease of terminal abdominal aorta and femoral arteries.

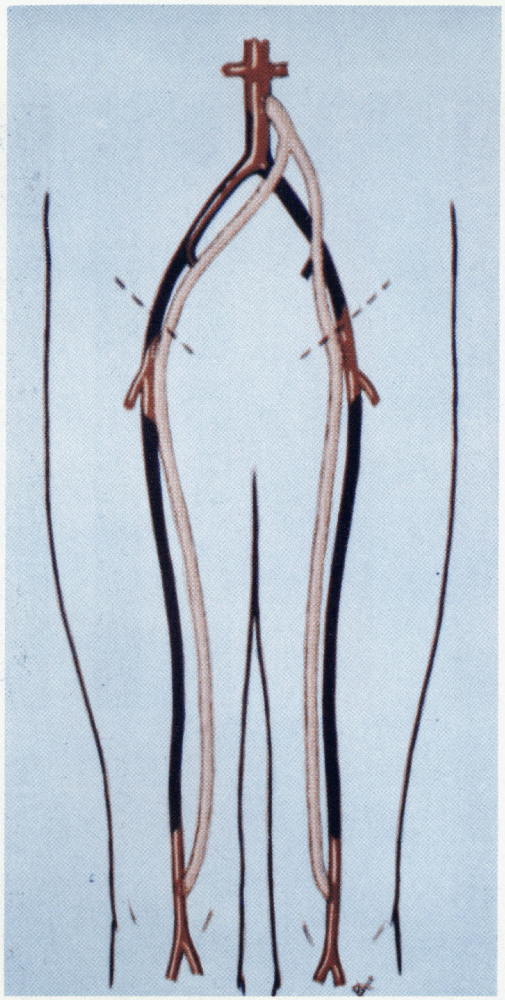


Fig. 2. — Drawing illustrating extent of occlusive disease and use of bypass Dacron graft in treatment of patient shown in Figure 1.

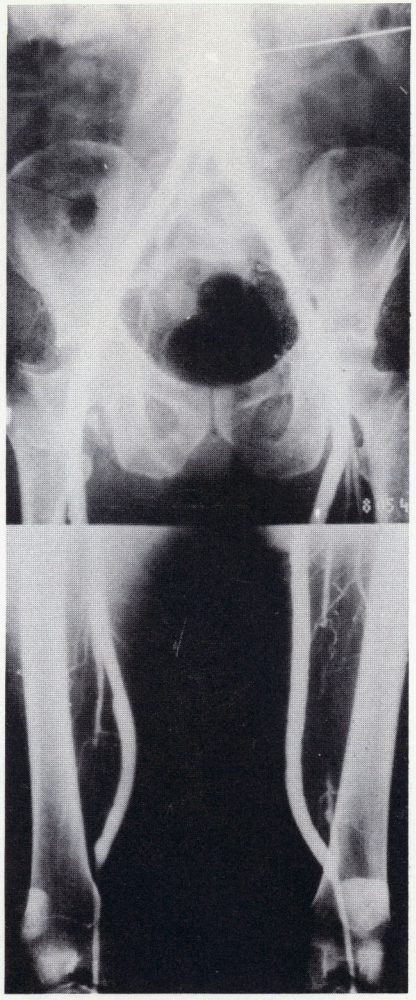
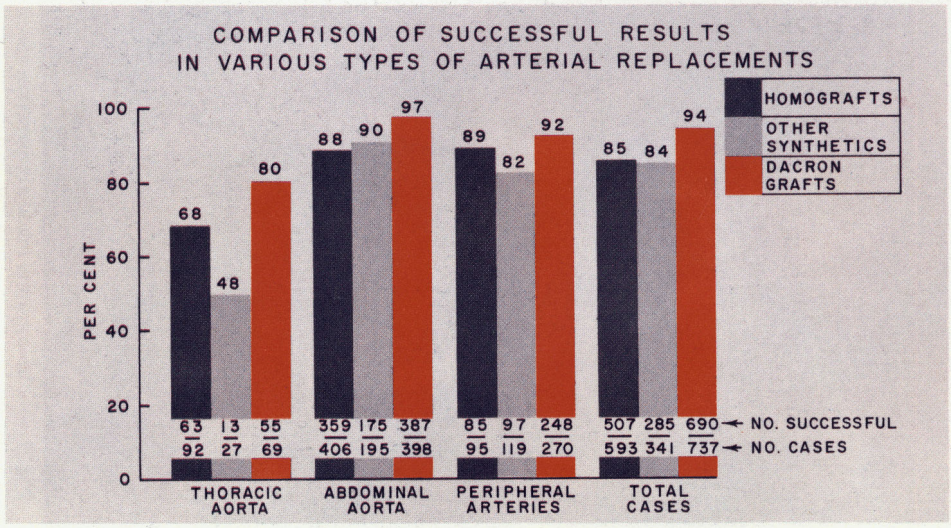


Fig. 3. — Aortogram made after operation in patient shown in Figures 1 and 2, showing restoration of normal circulation by means of the bypass Dacron graft.

RESULTS

DACRON GRAFTS	NUMBER CASES	DEATHS	GRAFT FAILURES	SUCCESSFUL
THORACIC AORTA				
ANEURYSMS	51	13 (25%)	0	38 (75%)
OCCLUSIONS	18	1 (5.5%)	0	17 (94%)
ABDOMINAL AORTA				
ANEURYSMS	235	6 (2.6%)	1 (0.4%)	228 (97%)
OCCLUSIONS	163	1 (0.6%)	3 (2%)	159 (98%)
PERIPHERAL ARTERIES				
ANEURYSMS	27	2 (7%)	1 (4%)	24 (89%)
OCCLUSIONS	243	2 (0.8%)	17 (7%)	224 (92%)
TOTAL DACRON GRAFTS	737	25 (3.4%)	22 (3%)	690 (94%)
TOTAL OTHER SYNTHETIC GRAFTS	341	29 (8%)	27 (8%)	285 (84%)
TOTAL HOMOGRAFTS	593	62 (10%)	24 (4%)	507 (85%)
TOTAL ALL GRAFTS	1671	116 (7%)	73 (4%)	1482 (89%)



Tabulation and graphic representation of results obtained from an analysis of our experience with 737 cases in which the Dacron graft was employed for the treatment of various forms of aortic and arterial diseases. A comparison of these results with those obtained in our previous experience with the use of other types of synthetic vascular replacements and with homografts indicates the Dacron graft to be superior in all respects. Both the mortality and the incidence of failures attributable to grafts were significantly lower in the Dacron series.